ACF COST MODULE METHODOLOGY

Introduction

The Annual Charge Factor (ACF) is a rate which converts an investment amount into an annual recurring cost that includes capital recovery, return on investment, income taxes, ad valorem taxes, and direct maintenance expenses. A monthly recurring cost is obtained by dividing the annual recurring cost by twelve.

ACFs are developed for each type of plant included in the cost studies (e.g., circuit equipment, underground metallic cable). They therefore reflect the unique attributes of the underlying asset such as varying economic and tax lives, maintenance expenses, and salvage values.

Major Determinants of Cost

The ACF calculation is a three-step process. First, the annual direct costs per dollar of gross investment for each year of the economic life of the asset are determined. These costs, net of any tax benefits, are discounted back using CenturyLink's weighted cost of capital. The ACF is then calculated by taking the average of all of these discounted costs. Therefore, the ACF represents the average of the annual levelized direct costs for each dollar of investment in a given asset.

Annual Charge Factor (ACF) Module

The ACF module workbook contains all of the calculated outputs (ACF factors). This module calculates and stores annual charge factors for each of the classes of plant.

Summary Worksheet

This worksheet compiles the ACF for each of the classes of plant found in the study.

Column A – Row #
Provides the worksheet row number.

Column B – Description
Lists the categories of plant under study.

Column C – Total Economic Rate Depreciation
This is the sum of the "Economic Depreciation Net Salvage" and the "Economic Depreciation First Cost" columns shown on the Cost of Capital worksheet.

Column D – Cost of Capital
Represents the total cost of the investment less depreciation and net salvage. The total cost of investment represents the annual cost of carrying the investment, which includes return of invested capital, return on invested capital, and the cost or benefit of removal or salvage value respectively. The cost of capital is calculated on the Cost of Capital worksheet of this module.

Column E – Income Tax
Accounts for the affect of state and federal income taxes on the return on investment. This factor takes into consideration the effect of differences in economic and tax depreciation lives as well as the company's capital structure. The income tax rate is calculated on the Income Taxes worksheet of this module.

Column F – Maintenance Expenses
This factor represents the annual maintenance expense for each dollar of investment. The Maintenance Expense factor is based on actual maintenance expense activity recorded in the general ledger of the company.

Column G – Ad Valorem Taxes
Accounts for the annual property tax paid by the company on investments located in the state.

Column H – Annual Charge Factor
This is the sum of columns C through G of this worksheet.

Cost of Capital Worksheet
This worksheet arrives at the cost of capital portion of the annual charge factor.

Column A – Row #
Provides the worksheet row number.

Column B – Description
Lists the categories of plant under study.

Column C – Economic Life (Years)
This column lists the life by which the asset is depreciated in the study.

Column D – Salvage Value
This column lists the value of the retired asset, net of any cost of removal, as a percent of gross investment.

Column E – Economic Depreciation First Cost
This column calculates the straight-line depreciation rate without regard to any future salvage value or cost of removal. The Total Economic Depreciation Rate minus the Economic Depreciation Net Salvage.

Column F – Economic Depreciation Net Salvage
This column calculates the straight-line depreciation rate of the net salvage value. Salvage Value divided by Economic Life (Years).

Column G – Total Economic Depreciation Rate
This is the sum of the straight-line depreciation rate of the asset and the straight-line depreciation rate of the net salvage value appearing in columns E and F, respectively.

Column H – Investment Annual Cost
Investment Cost represents the annuity needed to recover $1 of investment and the associated net salvage value.

Column I –Annual Cost of Capital
Cost of capital is the difference between the investment annual cost percent in column H and total economic depreciation percent in column G.

Income Taxes Worksheet

Column A – Row #
Provides the worksheet row number.

Column B – Description
Lists the categories of plant under study.

Column C – Economic Life (Years)
This column lists the life by which the asset is depreciated in the study.

Column D – Total Economic Depreciation Rate
This is the sum the straight-line depreciation rate of the asset and the straight-line depreciation rate of the net salvage value and is calculated in the Cost of Capital worksheet.

Column E – Salvage Value
This column lists the value of the retired asset, net of any cost of removal, as a percent of gross investment.

Column F – Tax Life (Years)
This column lists the appropriate tax life for each class of plant.

Column G – PV Tax Depreciation
Present value of tax depreciation is equal to the present value of the annual tax depreciation. Since tax depreciation is not straight line, a table appearing on the Tax Dep worksheet is used to calculate the present value.

Column H – Annual Cost Tax Depreciation
Represents the annuity necessary to arrive at the present value of tax depreciation appearing in column G.

Column I – Annual Cost of Salvage
Annual cost of salvage represents the annuity necessary to arrive at the future net salvage value.

Column J – Investment Annual Cost
Investment Cost represents the annuity needed to recover $1 of investment and the associated net salvage value and is calculated in the Cost of Capital worksheet.

Column K – Income Tax Annual Cost
Income tax annual cost represents the income tax on the equity portion of return on investment taking into consideration the effect of economic and tax depreciation life differences.

Tax Depreciation Worksheet
This worksheet presents the **Modified Accelerated Cost Recovery System** (MACRS) depreciation rates and calculates the present value of these depreciation rates. MACRS is the current method of accelerated asset depreciation required by the United States income tax code. Under MACRS, all assets are divided into classes which dictate the number of years over which an asset's cost will be recovered.

Column A – Year
This column indicates the year.

Column B – Discount
This column calculates the present value of $1 given the number of years appearing in column A and assumed cost of capital.

Columns C – I – Tax Depreciation Rates
These columns list the MACRS yearly depreciation rates for each of the given tax lives.

Columns J – P – Present Value of Tax Depreciation

These columns represent the present value of the MACRs yearly depreciation rates appearing in columns C-I. The discount factor appearing in column B is multiplied by MACRS depreciation rate.

ODC COST STUDY METHODOLOGY

Introduction

The purpose of the Other Direct & Common (ODC) Module is to calculate two additional components of the annual charge factor: one to recover the Other Direct expenses associated with unbundled elements, and one which provides a contribution to recover common costs.

Other Direct factors are developed for each unbundled element and then added to the Annual Charge Factor (ACF) to arrive at a Total Economic Cost ACF.

A single annual Common factor is identified for all categories of unbundled elements. Applying the Common factor to unbundled elements recognizes that common costs are a necessary component of the Total Economic cost for each unbundled element.

1. Detailed Network Element Diagram

Not applicable.

2. Major Determinants of Cost

Direct expenses, such as maintenance expenses, are a component of the ACF, and therefore are not included in the expenses that are represented by either the Other Direct or Common factors. Additionally, expenses that are non-UNE related, such as those that support Centurylink's retail operations, are also excluded from the expenses that are represented by the Other Direct factors.

3. Inputs (Input Module, ODC Worksheet)

The Input Module (ODC worksheet, Economic Inv worksheet, ACF worksheet) contains all of the necessary inputs for the ODC Module. The inputs stored in the Input Module are described below.

a. State specific regulatory fees (ACF tab)
Input value.

b. Telephone Plant in Service Account Balances (ODC tab)
Input values.

c. Building Investment Inputs (ODC tab)
Forward-looking investment per a special study.

d. Economic Investment Inputs (Economic Inv tab)

Economic investment for Loop, Switching, SS7, NID, and Transport is calculated by their respective cost modules.

5. Outputs

The ODC Module uses forward-looking economic investment amounts, actual General Ledger investment and expense information, and customer operations expenses to create two types of factors. The first type of factors created are the Other Direct factors which are added to the direct costs determined in the ACF Module to create a total Annual Charge Factor for each type of plant; the second factor is the Common Cost factor.

The ODC Module consists of six worksheets, which are described below.

a. Expenses Worksheet

The ODC methodology consists of four steps. The first step is to identify each General Ledger account as a direct cost, other direct cost, or a common cost. Each account is labeled “D”, “O”, or “C”, accordingly. Examples of direct costs include:

- Central office switching (6210)
- Operator systems (6220)
- Circuit Equipment (6230)
- Cable & wire facilities (6400)
- Depreciation associated with direct investment (6560)

Other direct costs include:

- Network support (611X)
- Provisioning (6512)
- Network operations (653X)
- Portions of General Support (612X)

Common costs include:

- Portions of General Support (612X)
- Executive and Planning (671X)
- General and Administrative (672X)

Note that some accounts identified as direct costs are not UNE-related and are excluded from further calculations. These excluded expenses include:

- Other terminal equipment (6300)
- Access expense (6540)
- Foreign Directory (portion of 6622)

Direct expenses are reflected in the direct expense ACF, which is calculated in the ACF Module of the Centurylink Economic Model. Direct costs are identified here and removed from the analysis to prevent double-recovery of these expenses.

b. Investment Worksheet

The second step is to develop a direct investment base for each network element. The General Ledger investment accounts are identified as direct, other direct, or common, in the same manner as the expense accounts. Each investment account is assigned to a network element based upon one of several drivers, as indicated in the “Assignment Driver” column. The drivers themselves are found on the “Drivers” Worksheet.

c. Other Direct Expenses Worksheet

The third step is to assign each other direct expense account to the network elements based upon one of several drivers, as indicated in the “Assignment Driver” column. The assignment drivers themselves may be a driver found on the “Drivers” worksheet or an investment account.

Return on land and building and other direct investments are also accounted for in this spreadsheet.

In the fourth step, the total other direct expenses associated with each network element is divided by the economic investment (found on the “Drivers” worksheet) associated with that network element to derive the other direct factor. Since this is stated as a percent of investment, it can be added to the direct expense factor developed in the ACF Module to derive a total Annual Charge Factor.

d. Drivers Worksheet

The “Drivers” worksheet shows the five main drivers used to assign expenses and investments to the individual network elements. These five drivers are:

- Economic Investment – The economic investment associated with each network element is calculated by the corresponding module within the Centurylink Economic Model.
- Economic Cost – The total direct expenses associated with the network element, including return and taxes.
- Annual Charge Factors – The annual charge factor associated with the network element, including return and taxes. Land and building annual charge factors are used to apportion land and building costs, including return and taxes, to common and other direct expenses.
- Building Usage Analysis – Building investment associated with each network element.

- Land Usage Analysis – Land investment associated with each network element.

e. Common Expenses Worksheet

Common costs cannot be logically allocated to individual network elements. Thus the ODC Module develops a single common cost factor which is applied to each network element. Since common costs are applied to the economic cost (not investment), the common cost factor is calculated and applied on a percent of economic cost basis.

f. Summary Worksheet

The "Summary" worksheet is a one-page exhibit which shows the results of the other direct and common cost factor calculations in an abbreviated form.

Loop Cost Module Methodology

Overview

The CenturyLink Loop Module investment studies are completed through a series of calculations that result in investments by service and by loop type for each wire center. The Loop Module (LM) is a state-of-the-art, outside plant modeling tool that builds a highly efficient, least-cost technology, forward-looking network and applies material and labor costs to determine loop investments. These investments are then fed into other modules of the CenturyLink Economic Cost Model (ECM), where cost is calculated. A full description of the LM, and how it fits into the ECM, is provided below.

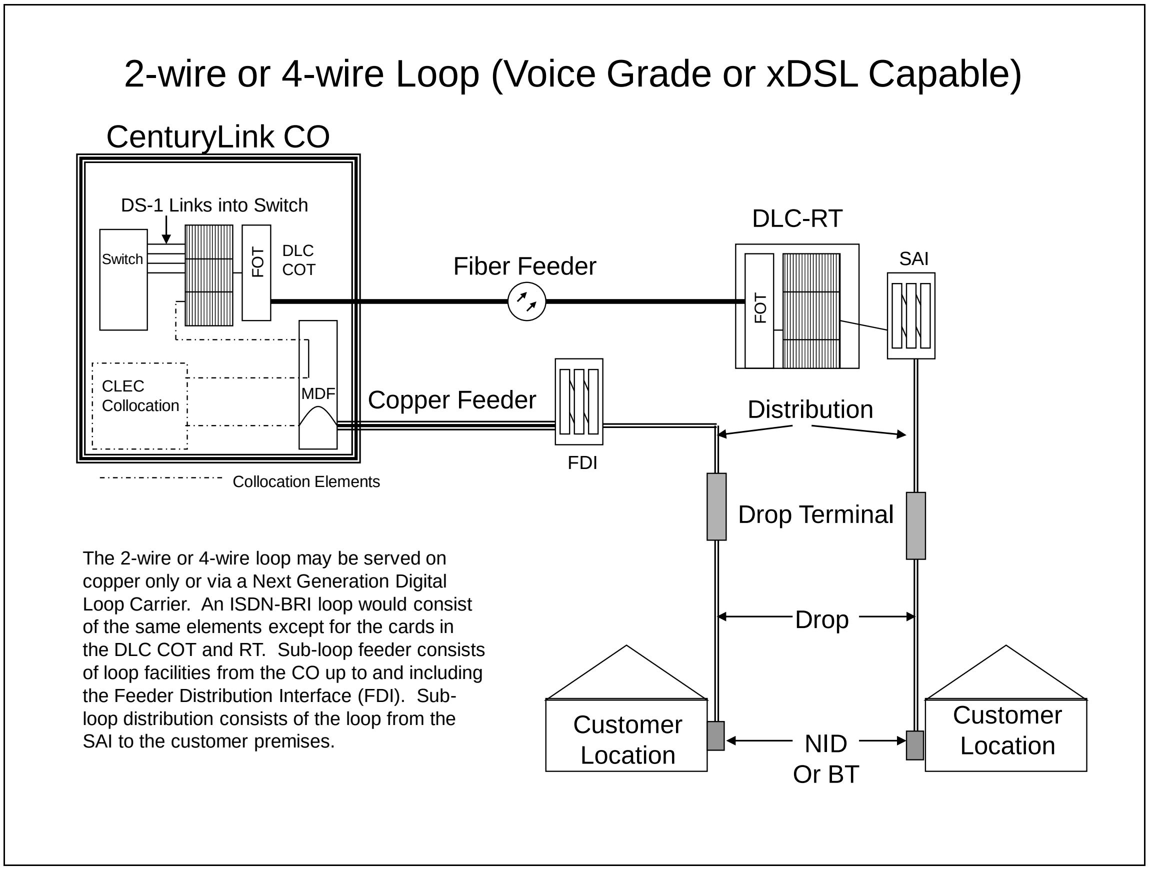
Introduction

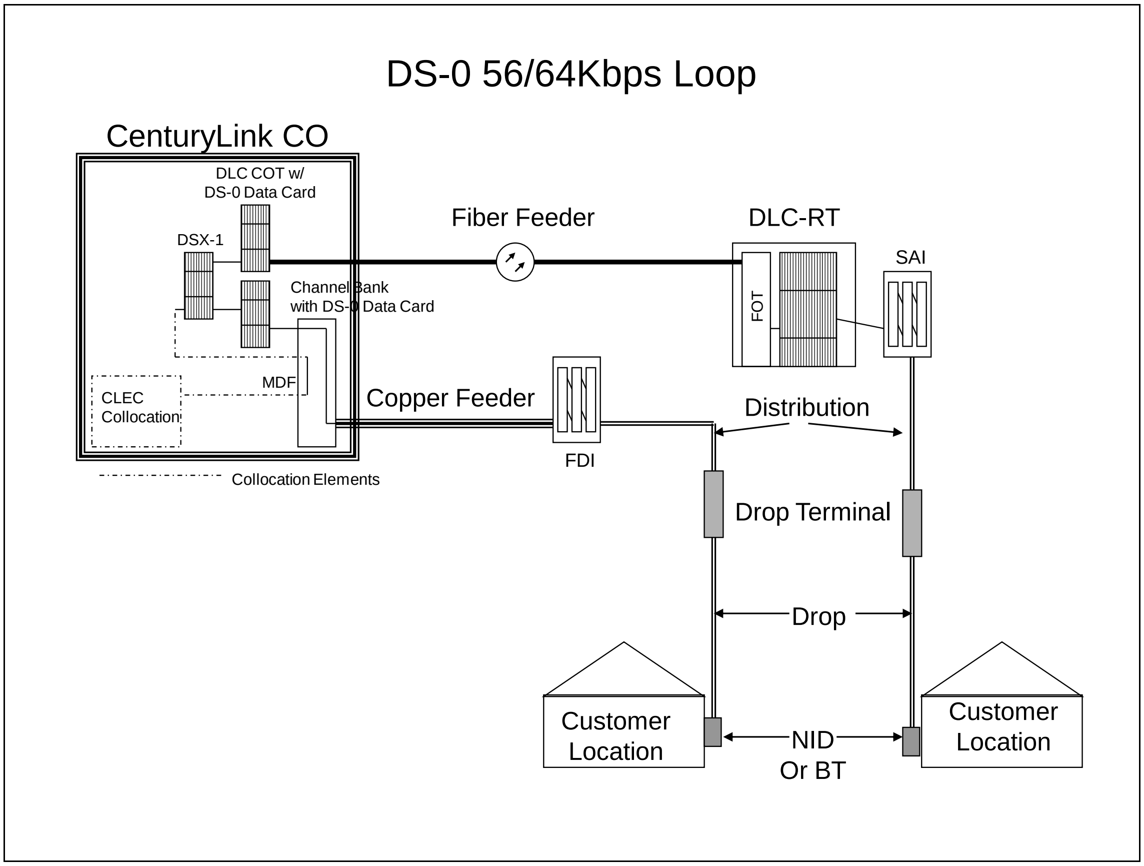
The LM is a next-generation, investment-development calculator for telecommunications outside plant and loop circuit equipment costs. This Loop Module is comprised of a Geographic sub-Module (GM) and a series of Microsoft Excel worksheets. The first step in the overall modeling process is the preparation of a map file that includes geocoded customer locations for all services by service address. A geocode is a geographical code used to identify a point or area at the surface of the earth. This mapped customer location file becomes a key input file for the Geographic sub-module. Within the Geographic sub-module, drop and building terminals are placed to serve the geocoded customer locations, after which optimized cable routes are built from the customer locations to the Feeder Distribution Interface (FDI), then to the Next Generation Digital Loop Carrier (DLC), and finally to the Central Office (CO) using a Minimum Spanning Road Tree (MSRT) routing. Remote DLC terminals and FDIs are optimally placed based upon industry standard carrier serving area (CSA) design. Within the Excel workbooks, demand quantities are calculated for each segment of plant, and material and labor costs are applied to the cable segments and other network components, to calculate forward-looking investments. The investment results are based upon a least-cost, most technically efficient design. The investment results reflect what CenturyLink would expect to incur on a forward-looking basis for rebuilding its outside plant network were it all to be done today. When used in conjunction with CenturyLink's other investment and cost calculators, costs for an entire local exchange network may be ascertained.

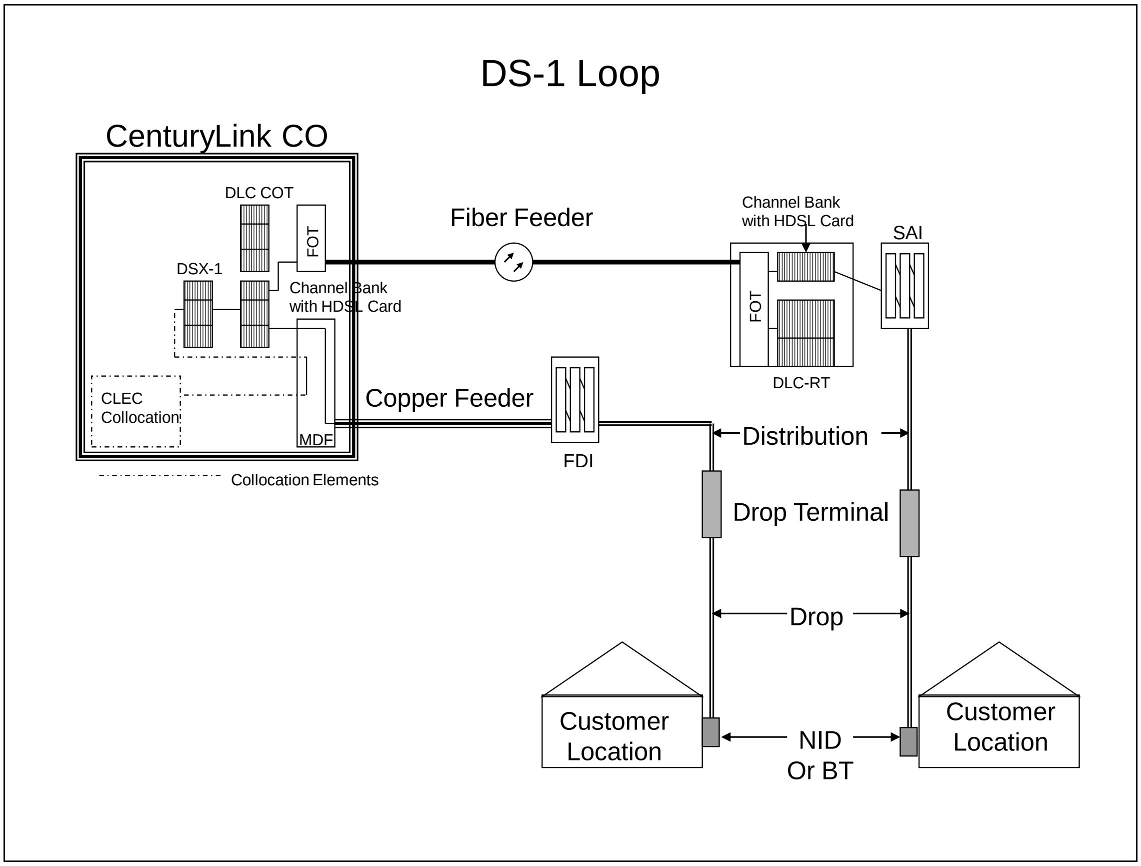
Network Element Diagrams

All loop elements DS-1 level and below have the same basic form. From the central office, the loop passes through the main distribution frame (or central office terminal) and proceeds along a copper feeder route to the FDI for an all-copper route, or along a fiber feeder route to the DLC and then on copper feeder to the FDI for a combined fiber and copper route. From the FDI, the loop continues along a distribution route to a drop terminal (DT), which connects the distribution facility to the drop, or directly to a Building Terminal (BT). The drop extends from the DT to the customer premises Network Interface Device (NID). All routing between these points are optimized using a road constrained minimum spanning tree.

Following are diagrams that depict voice grade loops, DS-0 56/64K loops, and DS-1 loops.




DS-0 56/64Kbps Loop
CenturyLink CO
DLC COT w/
DS-0 Data Card
DSX-1
Channel Bank
with DS-0 Data Card
MDF
CLEC
Collocation
Collocation Elements
Fiber Feeder
DLC-RT
FOT
SAI
Copper Feeder
FDI
Distribution
Drop Terminal
Drop
Customer
Location
NID
Or BT
Customer
Location



Determinants of Investment

Loop investment is a function of customer density, distance from the central office, terrain, weather, local market conditions, material costs, and loop type. Each variable is explained below.

Customer Density

Customer density is the single largest factor impacting the cost of local loops. Customer density is commonly expressed in terms of customers or access lines per square mile. The density of customers impacts loop cost in an inverse manner: the higher the customer density, the lower the incremental cost of the local loop. This relationship is linked to a few fundamental facilities, such as the requirement for a trench, conduit or aerial pole route regardless of whether a 25 pair or 2400 pair cable is placed. It is readily apparent that the greater the customer density, the more customers that can be served along a feeder or distribution cable route. Therefore, customer density ultimately determines how many customers or loops there are among which to spread the cost of digging a trench, placing conduit and/or placing an aerial pole line.

Customer density also drives the unit cost of other equipment components associated with loops. Loop components such as Feeder Distribution Interface

(FDI), Digital Loop Carrier (DLC) devices, and Drop Terminals (DT), as examples, are all similarly impacted by customer density and exhibit lower per unit costs as customer density increases.

Distance

The distance of a given customer location from the central office directly increases loop costs as the distance increases. This relationship results from the obvious need to place more cable, trenches, conduit and/or aerial pole lines as the distance or length of the loop increases. Loops over 12,000 feet require the addition of digital loop carrier equipment. Distance adjusts the required investment regardless of changes in customer density or terrain. As distance increases, it generally increases the overall cost and need for maintenance. Assuming constant customer density, longer cables have more splice points and resulting exposure to risk. Greater numbers of splice points means there are more areas for possible failure due to lightning, water, rodents, vandalism, and accidents.

Terrain

The type of terrain in which cable is placed impacts both the cost of the initial cable placement and the maintenance of the cable. The cost of below ground cable construction increases with the presence of rock or water within the placement depth, the hardness of the rock encountered, or a soil type that interferes with normal placement. Terrain factors such as the depth of the water table, the slope of the ground, dense tree areas, lakes, rivers, mountains, etc. all affect both the initial construction cost of loops and subsequent maintenance expense.

Weather

The extremes of weather affect the cost of maintaining cable, and therefore, figure significantly into the type of cable placed (buried, aerial or underground). The cost of maintaining aerial plant in geographic areas that frequently experience ice storms or tropical hurricanes is certainly greater than in those areas that seldom encounter these conditions.

Local Market Conditions

Issues such as local zoning laws requiring below-ground plant, screening and landscaping around FDI and DLC sites, construction permits and restrictions, heavy presence of concrete and asphalt, traffic flows, and local labor costs all impact the construction and maintenance costs of loop plant and will vary among locations.

Material Costs

CenturyLink uses current vendor material costs for cable and electronics. Material costs are a determinant of the cost of the network in that they are the basic components that make up the network, such as those for cable, DLCs, multiplexers, FDIs, drop terminals, and drops.

Module Overview

The Loop Module (LM) calculates investments for all loop plant items from the NID or building terminal at the customer premises to the DLC and SONET equipment in the central office. The LM uses a series of calculations to develop loop investments. Geographic data as well as material and labor data are fed into the worksheets, which triggers calculations to be performed that build the network and apply material and labor investments. The LM workbooks and the Geographical sub-module utilize current telecommunications industry standard engineering criteria for carrier serving area (CSA) design. This design uses 12,000 feet of cable to provide voice grade and higher bandwidth services. CenturyLink uses engineering criteria and design standards when building its own network that are consistent with the industry standard practices. The GM identifies the locations of the drop and building terminals. From there, it produces the optimized routing to connect all terminals with their respective Feeder Distribution Interfaces (FDIs). It then optimizes the copper feeder cable routes from the FDI to either the Central Office (if within the CO CSA), or the DLC for all other CSAs. Optimal fiber feeder routes are then built from the DLC to the CO.

CSA Design

Carrier Serving Area (CSA) design is the national standard used by carriers to design and build the network and by manufacturers to build electronics equipment to provision the network.

CSA design includes the use of a remote terminal (RT) within the CSA that was connected by carrier to a Central Office Carrier Terminal (COT). This would make all loops appear to the CO switch as if they were within the 12k ft. limit. The remote terminals used in the LM are fiber-fed to comply with forward-looking standards.

Loop Module Structure

Two modules make up the development process for loop investment - the GM and the LM. The GM is an automated process that develops geographically related input data for the LM. The GM is run using MapInfo software. The LM contains Excel workbooks that accumulate units and calculate loop investment for all loop elements. The LM uses a combination of Microsoft Access and Microsoft Excel. Data are stored or moved between workbooks with MS Access.

Customer Location and Cable Routing Methodologies

The customer location methodology used within the GM and LM utilizes actual CO locations, actual wire center boundaries, optimized CSA boundaries, optimized DLC and FDI locations, and actual customer locations within each CenturyLink wire center.

Customer geocoding uses data from CenturyLink's billing systems, data from publicly available sources, and MapInfo MapMarker software to geocode customer locations. Customers that did not meet at least a "ZIP+4" (5-digit zip code plus the four appended address digits) address status were given surrogate locations. These geocoded locations are then used to determine the placement of drop and building terminals.

Algorithms for building the local network were developed by Stopwatch Maps using logic they call "Minimum Spanning Road Tree" (MSRT), which builds optimized feeder and distribution routes along roads. The MSRT is based on the generally accepted Minimum Spanning Tree (MST) logic that calculates the shortest distance required to connect a series of points. MSRT connects all customer points to the applicable FDI, the FDI to its DLC, and the DLC to the CO using MST logic with an additional constraint that all pathing must follow roads. Local exchange networks, including CenturyLink's, contain cable routing along roads to provide the least-cost access to the physical plant. The result is a network that is forward-looking, least-cost, highly efficient, and follows current plant design parameters.

Surrogation Process

For any customer service point that falls outside of the GM's strict first requirement for placement, the GM establishes a surrogate location. The goal of the surrogation process is to place these customer service points at a location that is reasonably approximate to the location expected to serve the customer. The surrogate locations are placed in expected areas using a combination of actual Census Block residential household data and Dun & Bradstreet business data within the Census Block.

Cable Routing

Once all customer locations are assigned, the next step is building the network. The network is built from the customer location to the central office starting at the NID, then the drop, drop terminal, distribution cables, Feeder Distribution Interface (FDI), copper feeder cables, fiber feeder cable, and finally the central office. In a distribution area (DA), customer locations are connected to distribution or building terminals (DTs or BTs). The DTs or BTs are connected to the FDI with distribution cable. To model the DA, the GM must first generate and place the DTs and BTs and connect them to their customer locations. Next, the GM must determine, for each DT or BT, the FDI from which it is to be served. Within each CSA, the GM determines the FDI to which a DT or BT belongs by determining the shortest road path from that DT or BT point to any FDI of that CSA.

Once the GM establishes each distribution area within a CSA, the distribution cables are routed from each FDI to all the DTs and BTs that FDI serves. This routing is also strictly along roads. This process of efficiently determining the cable routes is referred to it as a Minimum Spanning Road Tree (MSRT).

Terminal Placement
The GM is responsible for placing the Distribution Terminals (DTs) and Building Terminals (BT) that feed the service locations for a wire center. A DT typically serves up to eight service locations and is located in close proximity to those service locations. Each service location is connected to a DT by a drop that, to meet loop transmission requirements, is no more than 500 ft. in length. DTs are in turn fed by distribution cable that originates at an FDI.

Feeder and Distribution Routing
After the DTs and BTs have been placed and assigned to customers, the GM must route the feeder and distribution cable for the wire center. The DTs and BTs are connected to an FDI via distribution cable. The FDIs are connected to a DLC by copper feeder cable. For the Carrier Serving Area around the CO (the CO CSA), the FDIs are connected directly to the CO with copper feeder cable. And finally, the DLCs are connected to the CO by fiber feeder cable.

Interoffice Routes
In addition to feeder and distribution cable, the GM calculates cable lengths *between* central offices through inter-exchange cable routing. The offices to be connected are specified and geocoded points established at boundaries indicating the actual crossing point of inter-exchange cable from this wire center's CO to the connected wire center. This location record is similar to a customer location, but contains a unique "class of service" indicator and the quantity of fibers that route between the offices.

Geo-processing Results
The result of the GM processing is a series of tables with customer location data and network component data. Within the Service Locations table, a service location represents a single structure having one or more customers. Customers (and their lines) are rolled up by address during pre-processing to produce these service locations. The Outside Plant Elements table is a MapInfo table with point objects representing the location of the outside plant elements for a wire center. Elements that appear in this table include the CO switch location, DLCs, FDIs, and feeder and inter-exchange routing points.
Records in the results are interrelated to designate each segment or element in the distribution and feeder cable paths that connect the customer to the CO switch. Every element is assigned a number. The next segment in line toward the central office that it connects to is its parent. Each record includes the field side element and the segment of cable on its CO side. The parent/child relationships for each element can be identified to trace a cable route and identify the characteristics of each segment of the cable route. The record for a CO

switch does not have a parent element because it is at the top of the network hierarchy. In turn, the very last terminal on a distribution leg has no child since it is at the very end. Often a cable path splits into multiple directions to reach its target elements. Such splits are represented by an element record called a splice. Splice records are necessary to denote the location cable splits and indicate where service counts are aggregated.

A pictorial example will help explain the relationship. In this example, five elements are depicted. An FDI has a section of cable that ends in a splice. Two distribution cables exit the splice. One cable segment ends at a distribution terminal. The other segment ends at a distribution terminal which, in turn has another segment of cable with its distribution terminal.

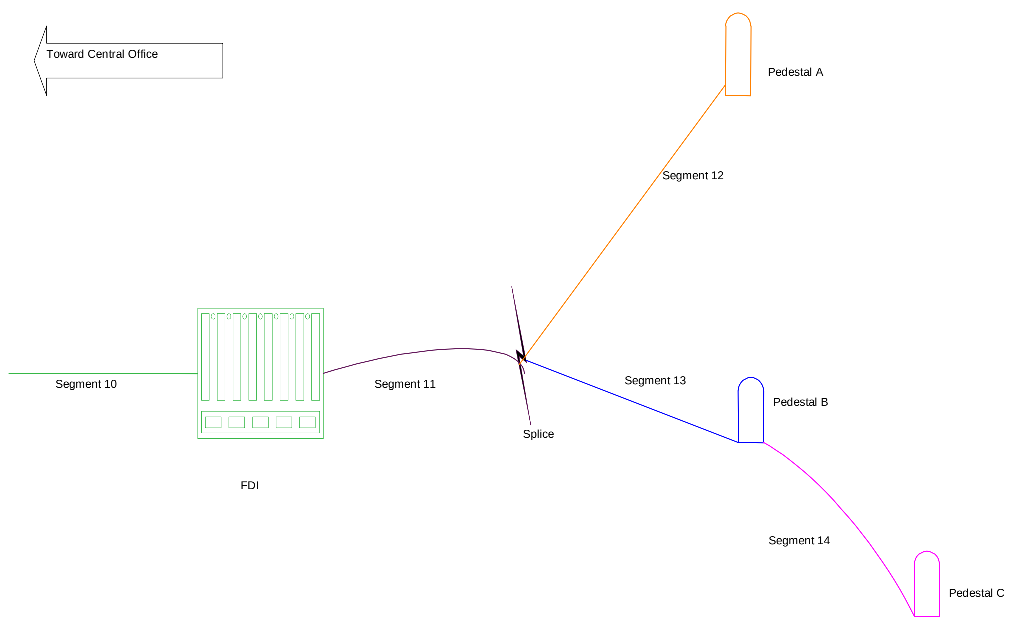


Figure 1

Segment 10 is a segment of cable ending with the FDI. Segment 11 is a segment of cable ending with a splice. Segment 10 is the parent of 11. Segment 11 is the child of segment 10 and the parent of both segment 12 and segment 13. Segments 12 and 14 are children but have nothing to parent.

Loop Module Organization

Once the GM has completed its processing, the results are fed into a Microsoft Access database. During the investment processing, the results of the GM are queried by wire center, and fed into Microsoft Excel templates, where investments are calculated for each cable segment and the attached item of plant if present. (Splices, routing points, and interexchange points have no plant items attached to the cable segment.) Once investments are calculated, they are passed to other modules within the ECM for costing.

The LM pulls in both data from the GM processing, and data from the cost and assumption input files. The GM output contains a row of data for each cable segment and attached plant item in the wire center. That data is entered into a tab in various loop workbooks used to calculate the investment for each item, the demand placed on that segment and item either from itself or all of its accumulated children, and ultimately the total loop investment associated with each service class in the wire center. The loop assumption input file contains inputs related to material prices, labor prices, and factors related to plant mix and plant utilization. Excel workbooks are organized with multiple worksheet tabs. These workbooks are processed automatically in sequence by the LM as it steps through the investment modeling procedure.

LM Input

An overview of the types of inputs used within the model is presented below to complete the discussion of how the model is organized. Inputs for each scenario are stored in MS Access and pasted into the workbooks as needed during model processing.

Loop Cost Inputs

Material costs for drop, NID, terminals, copper and fiber cable, indoor and outdoor FDIs, and the strand for hanging aerial cable are contained here. Inputs for cable, NID, and FDI include labor for installation and engineering.

Structure

Structure represents the cost of the trench, conduit system, or pole line where the copper or fiber cable runs. The inputs related to burial activities, trenching for conduit systems, and cost of poles are developed here.

Manholes

Manholes inputs account for material costs for various sized handholes, manholes and conduit. Labor for engineering and installation are included in the inputs. The LM selects the appropriate sized manhole based on the number of ducts needed for the route.

Spacing

The table contains the average spacing between manholes, poles, and anchors.

Percentages
Inputs related to the proportion of plant that is aerial, buried, or underground are contained here. Inputs related to cable utilization are also presented.

Miscellaneous Inputs
This tab contains a series of individual input values for key assumptions such as cable placement depth, electronic fill, maximum system and cable sizes, etc. These values were set in the input phase of the process and are pulled from the comparable values in the input module.

Miscellaneous Tables
The tables found within this tab contain data relating to the sizing of SONET systems and DLC cabinets, capacity and configuration of DS-1 channel banks within the DLC cabinet, labor hours for installs, and the pair and bandwidth requirements for each of the circuit types. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Unit By Density Tables
This tab contains tables that designate cost for any given plant unit by size and by density. Sizing and costs are included for items such as fiber and copper cable, drop terminals, drops, NIDs, and indoor and outdoor FDIs. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Density By Unit Tables
The tables within this tab contain factors used to configure the loop network such as cable fill, plant mix (aerial, buried, or underground), pole and manhole spacing, and structure costs by surface condition. All tables contain values that vary by density. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Fixed Tables
The tables within this tab contain tables that relate: 1) The many soil types to a placement difficulty indicator (0 is normal and 1 is difficult); 2) The density to a reference column for lookups in other tables, and 3) Central office information to the wire center reference number. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Master Price List
The Master Price List is used by the loop module and transport module for material costs related to DLCs, channel banks, and SONET terminals. This table is pasted into the loop module as needed and the data is aggregated into functional DLCs, channel banks, and SONET terminals based on vendor specific configurations that CenturyLink deploys in its network.

Loop Plant Methodology
The LM calculates investments for all loop plant items from the NID or building terminal at the customer premises to the DLC and SONET equipment in the central office.

Accumulations of Distance and Service Counts by Segment
All accumulations are based on the segment identifier number and parent-identifying number developed by the GM and input into the respective data tabs of the LM workbooks.

Distances
The data transferred into the LM from the GM contains the length of each cable segment. To determine the total loop lengths, feeder lengths, or distribution lengths, these segment distances are accumulated from the appropriate starting parent through any intermediate segments that occur in the specific segment's lineage to it. The starting parent is the CO for any fiber feeder serving DLCs, customer SONET locations, and interexchange routes, or for the copper feeder in the CO CSA. The starting parent is the DLC for copper feeder in DLC served CSAs. The FDIs are starting parents for all distribution.

Pair, Fiber, and Service Counts
In order to determine the capacity requirements for all units of plant, these counts are aggregated from the most distant child through the lineage to the segment in question. Distribution and Building Terminals at the extremes of the plant are the starting children. Counts are aggregated to the associated parent. Cable splices will have more than one child to aggregate, as will most FDIs and DLCs. Working pairs or fibers are accumulated to size each cable segment. Pairs and services are accumulated to size FDIs and DLCs.

NID
A NID is placed at each customer location that requires six or less pair terminations using drop wire. Fiber and certain service types are not terminated on NIDs. Locations that require more than six pair and are not fiber based will terminate on a building terminal.

Drop Terminal
The criteria for placement of the drop terminals (DTs) are input by the user in the GM's parameter table. Parameters include the maximum drop distance and the maximum number of drops/NIDs served per terminal. The maximum drop distance is set by default to 500 feet to meet transmission requirements for the loop signal. The GM places the correct number of terminals to meet these two criteria. Each drop terminal is sized to meet the capacity specified in the data inputs passed from the GM.

Building Terminal
Building terminals (BTs) are placed at the customer location and set back from the distribution cable along the road with a connecting cable sized to match the terminal capacity. They are used for all copper cable terminating customer locations that exceed 6 pair or require pair separation, such as DS-1s.

Outside building terminals are sized in increments of 25 pair, to a total capacity of 150 pair, and include the appropriate grounding. If the BT capacity exceeds 150 pair, an indoor FDI is placed at the BT location. BTs are sized to the total capacity required for all customers at that customer location.

Customer SONET Terminal & High Capacity Services
Each customer location that originates one or more DS-3s or higher bandwidth services is configured for SONET fiber optic termination at that location. The customer SONET terminal is sized for the total bandwidth specified by the sum of the high capacity circuits. All capacities are converted to DS-3 equivalents to derive the overall bandwidth needed. To the base SONET terminal or terminals configurations, the required number of interfaces by service type is added. For example, if a customer location specifies four DS-3s and an OC-3, the correct number of both DS-3 and OC-3 interfaces are placed into the terminal configuration. Where multiple interface card options exist within the terminal, the least-cost alternative is calculated and used. A corresponding CO terminal is placed. The CO terminals takes advantage of equipment frame sharing by assigning the number of frame inches needed for each system, thereby, reducing the CO SONET based costs. All SONET systems assume the typically customer specified redundant transceiver and fiber capacity.

Feeder Distribution Interface
Feeder Distribution Interfaces (FDI) are sized for total distribution and feeder pairs required to be terminated. The total count of distribution pairs terminated is added to feeder cable(s) sized to meet the total working pairs in the FDI, and divided by the feeder fill. Should the maximum cabinet capacity be exceeded, the number of fully occupied cabinets is calculated along with one that is sized for the residual pair count. If, for example, 8500 pair terminations are needed, a maximum cabinet of 7200 terminations is assigned along with one that serves the residual 1300 pair, i.e. an 1800 pair cabinet which is the next standard size that is stocked to serve 1300 or more pairs.

DLC Terminal Location
The DLC terminal location is comprised of one or more DLC cabinets that contain standard DLC equipment serving voice and DS-0 services via the DLC equipment. A SONET terminal is configured within each DLC cabinet with sufficient bandwidth to serve the total capacity requirements of the DLC equipment and all attached DS-1 channel banks. The appropriate DS-3 and/or OC-3 interfaces are placed in the SONET terminal. The SONET terminal cost is

allocated between the VG, DS-0, and DS-1 services on respective bandwidth required.

DLC cabinets are selected from a table with the various cabinet configurations supporting voice shelf and DS-1 counts needed within the cabinet. The number of DS-1 units is first determined. Then the voice capacity is looked up and matched to the column in the cabinet table with the number of channel shelves. This cabinet configuration is then used for the DLC costing at that location. Should the location demand exceed the maximum capacity of a DLC cabinet, the number of fully populated cabinets is calculated along with the capacity of the overflow or residual cabinet. The cabinet and all equipment shared by the total spectrum of services are allocated to those services using the respective bandwidth or shelf and frame space requirements.

DLC TDM Equipment

The TDM equipment is sized to meet the total VG and DS-0 demand after the application of the electronic fill factor. Space utilized by the TDM equipment and the space cost is first allocated to the common equipment and the individual service cards. The common equipment cost including transceivers is then allocated to the services based on the bandwidth demanded by each.

Channel Bank Equipment

The channel banks provisioned in the DLC are electrical DS-1 to optical multiplexers. The multiplexer optics are routed with fiber jumpers to the cabinet SONET terminal. The quantity of channel bank shelves placed is based on the total DS-1 equivalent demand at the location. If multiple shelves are required, shelves will be added in single shelf increments. The first shelf in a group uses a DS-3 optical transceiver. An OC-3 transceiver is used for 2 or 3 shelf configurations. When more than 3 shelves are needed, an overflow group of 1, 2, or 3 shelves is placed.

Distribution Cable

Distribution cables are placed from all BT and DT locations to their assigned FDIs. Cable routing is determined within the GM using a distance minimizing algorithm called Minimum Spanning Road Tree (MSRT). This algorithm computes the routing to minimize the overall total distance to connect all points within the FDI served distribution area similar to a Minimum Spanning Tree or MST calculation. In the MSRT, a road constraint is added to recognize that cable plant is normally routed along roads to allow ready access for plant maintenance personnel. This ensures that a minimal but reasonable distance applies. This causes structure costs, a key driver of the distribution cost, to be minimized, yet subject to the road constraint. When copper distribution cables are placed along the same route as optimized feeder cables, the cables share a common structure for the distance that overlap occurs, and are each allocated a portion of the shared structure. This also contributes to the model’s ability to produce the least-cost solution.

When copper cable is sized, the accumulated total terminated pairs are used to look up the appropriate cable size. As the routing progresses from terminal to terminal or through a splice, the total number of pairs required for each segment is used to size the cable. Because distribution cable is sized based upon terminated pairs, the fill factor used in the calculation is defaulted to 100 percent fill.

Copper Feeder Cable
Copper feeder cable is built from the FDIs in the network to the DLCs, or in the case of the CO CSA, the central office. Routing is again computed to a minimum total distance solution using the MSRT algorithms, discussed above, for all copper feeders. Any customer fibers that appear at an FDI are jointly routed with the copper to its DLC location where it joins other fiber feeders. Fiber and copper cables are aggregated along the route when they join in a common route.

Copper cables are sized to the total working pairs along each segment after application of the copper feeder fill factor. When the total pairs required are matched to the cable sizing table, the achieved fill factor will normally be less than the input objective, since the sheath size almost always exceeds the required pairs. To make the cable closely approximate the target once cable sizes are determined, the achieved fill is matched to the target fill. An adjustment is calculated to the fill input and applied to a second calculation of cable size. With the adjustment in place, the achieved fill is very close to the target fill – in effect removing the fill adjustment caused by moving to the closest actual cable size. It is this adjusted cable size that is used in calculating the cost of the cable segments.

With the minimized distance algorithms and fill maximization in place, these copper cable calculations produce a highly efficient, least-cost feeder network. Copper costs are allocated to the services on the basis of pairs used to total pairs in use.

Fiber Feeder Cable
Fiber feeder cables serving customer locations with SONET terminals are sized to match the capacity requirements of each of the customer SONET systems. The number of fibers per system is an input set by the user in the input phase of the modeling. Working fibers have the fiber fill factor applied to calculate the required sheath size for any customer fiber only cable segments. Customer fibers are routed from the customer locations to the CO.

Fiber feeder cable is also placed from the DLC locations to the CO. Cable segments are sized to carry the DLC SONET fibers found at each DLC location.

Fiber feeder cables also contain the capacity requirements for all interexchange (IX) fibers. Actual fiber boundary “crossing points” are entered into the GM along with other customer geocoded points. The GM routes the IX cable from the boundary to the nearest DLC or the CO – whichever is closer. If the IX fibers are routed to the CO and pass a DLC, the IX fiber load is added to the other DLC and customer fiber requirements that share the route segment.

Fiber cables are routed from the customer, DLC, and IX locations to the CO using the same MSRT total route distance minimization algorithms discussed previously. As the name implies, the road constraint continues to be applied to the distance calculations. Where fiber cables follow the same route as copper feeder cables, the cable structure is allocated between the two for the common distance.

Fiber sizing calculations use the accumulated customer, DLC, and IX fiber counts by segment. Cables are sized to meet the fibers required after the "grossing up" application of the fiber fill factor. The aggregation of fibers, the sharing of structure with copper, and the minimizing of total route distance makes the fiber cable costing highly efficient and produces the least-cost alternative.

Poles

Poles are placed along all aerial segments of cable. Pole cost, the sharing with other utilities or providers, and maximum spacing inputs are set by the user in the inputs phase of the process and carried forward into the LM. A pole is placed at each end of a segment. If the segment is greater than the pole spacing user input, additional poles are added to maintain the spacing interval on all but the final span.

Conduit

The number of ducts in the underground cable segments is computed for both copper filled and fiber filled ducts. Full sized ducts are used for each copper cable. Ducts used for fiber cables include innerducts. The number of innerducts in a 4" conduit is specified by the user in the input phase. The number of ducts includes one for each copper cable and a maintenance spare plus sufficient fiber/innerducts to match the fiber cable count plus one. For example, if the number of innerducts per 4 inch conduit is three, and two fiber cables and two copper cables are required, the total number of ducts will be four, with one of the four equipped with innerducts. (Two plus a spare plus one fiber duct with two of the three innerducts occupied.) Since there is no spare capacity in the duct run, no sharing of the ducts is permitted. Structure sharing is permitted in the duct trench and in the manholes.

Once the number of ducts is calculated, the manholes are sized to the total number of ducts in the cross-section. If more than nine ducts are required, manhole extensions are added to reach the full capacity. Manholes are spaced according to the spacing interval user input set in the inputs phase of the process.

The cost of ducts is directly assigned to the cable type that uses the duct. Manhole and trench cost is allocated to fiber and copper based on the proportion of total ducts placed. Fiber and copper total conduit costs are allocated to the services that ride each on the basis of cable usage.

Structure Sharing

Any facility segment that contains both fiber and copper cables, multiple copper cables, or multiple fiber cables either through multiple cables along the same segment or an overlap of fiber feeder, copper feeder, or distribution cables, has its structure allocated to the cables in the segment. All cables share all structure costs between the multiple cables that have a common routing. For example, fiber from customer high capacity circuits may parallel some length of distribution copper or copper feeder between the DLC-RT and the FDI. The structure costs are allocated to all parallel cables in the segment or portion of the cable segment that utilize that structure. Where the total number of cables exceeds the capacity of the structure, additional structure costs are added for the additional capacity. Structure costs reflect the density and terrain characteristics for each CSA, through which it passes or serves. Figure 2 illustrates the Loop Module's approach to structure sharing.

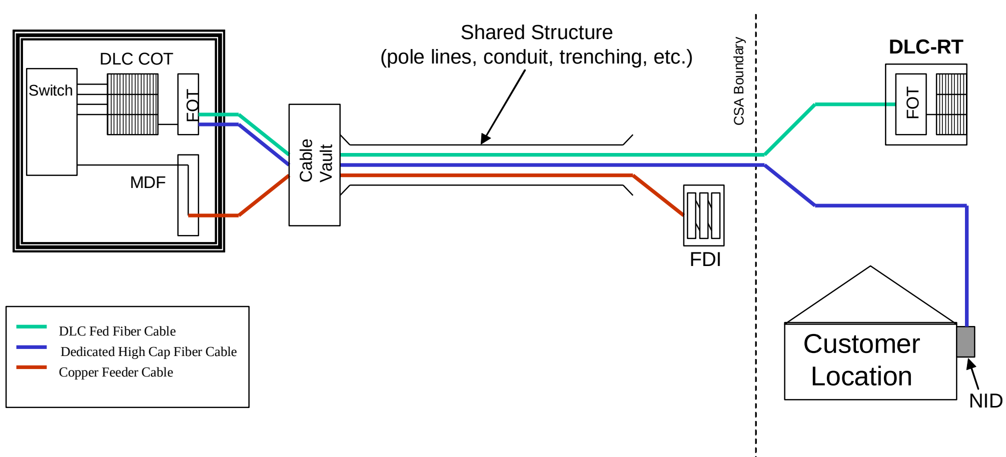


Figure 2

The GM is able to determine where the layers (fiber feeder, copper feeder, and distribution) overlap. This is reported to LM with the GM outputs. To complete the sharing calculations, parallel cables within the same layer share the cost of the common structure. (When sharing capacity exists in a layer's structure and sharing is completed between layers, each layer reduces the shared portion of the segment distance by half of its shared distance for structure calculations only.) In that way, each layer receives one half of a structure that when added together recognize the complete structure cost.

Loop Cost Calculations

Once investments for outside plant and loop circuit equipment are calculated for all wire centers, the results are loaded into the cost input file of the ECM. Within ECM, cost factors are built and then applied to the investments to determine costs. Common cost is also built and applied. The following discussion focuses on the Loop component of the ECM.

Loop Summary Cost Methodology
The following discussion applies to 2-wire loops. Further discussion is provided for other types of loops. Global results and exchange-specific results are obtained from LM and are then fed into the ECM. The investment data includes

- Circuit Equipment or Electronics Investment
- Buried Cable Metallic
- Aerial Cable Metallic
- Underground Cable Metallic
- Buried Metallic Drop
- Buried Fiber
- Underground Fiber
- Buried Fiber/Fiber Drop
- Conduit
- Pole Lines
- Aerial Fiber
- Total lines served in the wire center

At a statewide level, these results are utilized to calculate Annual Charge Factors (ACFs) that reflect annual cost recovery requirements. For the loop annual charge factors, the investment for DS-3 loops and IX dark fiber are included to calculate weighted annual charge factors for those services

The wire center specific variables entered into the ECM also include the above referenced variables. However, at a wire center level, average investment per line is used. CO Termination inputs are based on data found in the CenturyLink Switching Module.

The ECM is used to calculate cost by wire center using the investments developed in LM. In the LoopSummary.xls file of the ECM, multiple tabs contain the cost calculations for various types of loops. Within each tab, ACFs are multiplied by the investment to determine annual cost recovery requirements for each plant account. Once annual cost recovery requirements are determined for each account, the results are summed and divided by 12 to obtain monthly cost. Common cost is also applied.

Once monthly cost by wire center is identified, the costs are grouped into rate bands. Within the Loop Banding tab of LoopSummary.xls, the exchange-specific results are sorted from lowest cost to highest. The wire centers may then be grouped to develop deaveraged loop costs.

4-wire Loops
Using the 2-wire loop cost as a base, the cost for 4-wire loops is the incremental cost of an additional pair of copper wires.

To determine investment for 4-wire loops, overall investment in copper, fiber, and circuit equipment is identified from the LM. The additional cost of 4-wire loops is based upon the circuit card required and the additional cable pair for any copper portion of the loop and the expanded bandwidth on the fiber.

DS-0 56/64K Loops
The purpose of the DS-0 loop study is to determine the economic cost of a DS-0 56/64Kbps grade loop.

To determine the economic cost of DS-0 56/64K loops, the costs for providing DS-0 on copper and fiber are identified. The cost to serve DS-0s on copper includes channel bank capacity and DS-0 cards. DS-0 56/64K loops served through digital loop carrier systems require additional investment to account for cards in the DLC. The costs for DS-0 loops served through DLCs represent the line cards in the central office terminal and remote terminal necessary for DS-0 loops. Average investment per DS-0 loop is obtained from LM and the monthly cost is calculated using methodology described above.

DS-1 Loops
Assumptions:

- Costs for providing the loop on copper and behind a DLC are included in the study.
- Loop conditioning costs are not included in the monthly recurring charges.
- A DS-1 loop is a dedicated facility that provides 1.544 Mbps of bandwidth.
- A DS-1 loop may be used to provision ISDN-PRI. Additional costs related to switching are required for ISDN-PRI and are not accounted for in the DS-1 loop cost study.

The monthly cost is calculated using the methodology described above.

ISDN-BRI/IDSL Loop

The following assumptions were used in the ISDN-BRI/IDSL loop cost study:

- ISDN-BRI/IDSL provides 144Kbps bandwidth.
- The cost does not include customer premises equipment.
- IDSL is the digital subscriber line equivalent of ISDN-BRI.
- The ISDN-BRI loop does not include any investment for switching functionality.

The costs for ISDN-BRI loops served through DLCs represent the line cards in the central office terminal and remote terminal necessary to ISDN-BRI loops. Average investment per ISDN-BRI loop is obtained from the LM, and the monthly cost is calculated using the methodology described above.

NID

Inputs for material and installation are identified and entered into the LM, which determines the number of NIDs and total investments. Smart jack investments are included as part of the DS-1 loop. Investments are then fed into the ECM, where cost is calculated. All loops include NID as part of the cost.